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Environmental interventions for altering eating behaviours of employees in the workplace: A systematic review.

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ABSTRACT

Environmental, or 'choice-architecture' interventions aim to change behaviour by changing properties/contents of the environment and are commonly used in the workplace to promote healthy behaviours in employees. The present review aimed to evaluate and synthesize the evidence surrounding the effectiveness of environmental interventions targeting eating behaviour in the workplace. A systematic search identified 8157 articles, of which 22 were included in the current review. All included studies were coded according to risk of bias and reporting quality, and were classified according to the emergent typology of choice-architecture interventions. More than half of included studies (13/22) reported significant changes in primary measures of eating behaviour (increased fruit/veg consumption, increased sales of healthy options, and reduction in calories purchased). However, only 1 study produced a small significant improvement in weight/BMI. Many studies had a high or unknown risk of bias; reporting of interventions was suboptimal and the only trial to measure compensatory behaviours, found that intervention participants who ate less during the intervention ate more outwith the workplace later in the day. Hence, we conclude that more rigorous, well-reported studies that account for compensatory behaviours are needed to fully understand the impact of environmental interventions on diet and importantly on weight/BMI outcomes.

INTRODUCTION

Diet and diet-related risk factors account for around 17 million deaths a year (1), largely as a result of the robust association between suboptimal diet and weight gain. In developed Western countries, 20-30% of adults and 7-13% of children under the age of 5 are currently obese (2). Such high levels of obesity result in adverse physiological and psychological consequences for individuals, and substantial healthcare and economic costs for society (3-5). For example, the financial cost of diet-related disease and ill health to the UK health service is estimated to be around £6 billion per year (6).

Private and public employers also bear a substantial diet-related burden. Obesity is reliably related to increased sickness absence and absenteeism in employees (7-10), and to more frequent injuries at work and compensation claims (7). Consequently, employers have a strong incentive to actively pursue strategies to improve the health of their workforce (11).

From a public health standpoint, workplaces may have unique potential as a setting in which to deliver health interventions (12,13). Full time employees spend up to 60% of their waking hours at work, and typically return repeatedly to the same location, providing a significant opportunity to deliver health interventions to a 'captive' population (14). In addition, workplace-based interventions have the potential to improve the health of a socioeconomically and culturally diverse section of the population by targeting people employed at all levels of a particular setting (15).

Healthy workplace interventions to date have typically focussed on education, motivational counselling, and effortful behaviour change, that is, on individual responsibility for health. However, much human behaviour is not actually based on conscious deliberation or knowledge, but rather is cued automatically by the environment with little or no conscious awareness (16). The modern environment has been described as 'obesogenic', or obesity promoting (17) with studies demonstrating that unhealthy consumption levels are partially driven by environmental factors such as the availability, proximity or appearance of food (18). Consequently, modifications to the environment have the potential to promote or encourage healthy actions (19) and can be used as the basis of workplace health interventions (20).

Environmental, or 'choice architecture', interventions are strategies that "do not require the individual to self-select into a defined programme" (21). These interventions are about altering the placement or properties of objects/stimuli in the environment with the aim of

changing health relevant behaviours (18). Examples of such interventions include moving healthy options closer to customers in cafeterias, increasing the relative availability of healthy options, labelling healthy foods to make them easier to identify, improving the ambience of places where foods are consumed, altering plates and packaging, changing the sizing of food portions, and placing healthy eating prompts in the environment. Interventions of this type have three theoretical advantages over individually targeted interventions. Firstly, they are thought to work primarily via automatic or non-conscious processes so do not require individuals to 'buy in' to the intervention or exert effort to change behaviour. Secondly, if effective, they are likely to be cost-effective to deliver as the resource required to deliver the intervention is typically low yet all target group members are exposed. Finally, they may overcome challenges in other types of intervention programmes where disadvantaged groups (e.g. low socioeconomic status individuals) are often underrepresented. However, these advantages are only relevant if the interventions in question are well-described, rigorously evaluated, and effective in terms of producing measurable changes in relevant behavioural (e.g. consumption) and health (e.g., weight) outcomes. It is as yet unknown, how effectively such environmental interventions have been applied within the context of the workplace.

The aim of the current study is to critically evaluate and synthesize the evidence from studies evaluating environmental interventions for altering eating behaviour in the workplace. To the authors' knowledge, this is the first review to focus purely on environmental interventions targeting eating behaviour within the workplace. The present review uses an inclusive search strategy to capture as many relevant studies as possible and rigorously assesses both the methodological and reporting quality of included studies. All interventions identified are coded according to Holland et al's (18) emergent typology of choice architecture interventions so that a picture of both intervention type and effectiveness can be built up.

Specific research questions are:

1. How effective are environmental interventions for altering eating behaviours of employees in the workplace?
2. Do environmental interventions in the workplace have an effect on secondary outcomes related to eating behaviour (e.g., weight, BMI, body fat, etcetera)?

If meta-analysis is not possible, results will be narratively summarised. In addition, the present study will assess the utility and coverage of the recently published typology of choice architecture interventions (18) for coding environmental interventions as they appear in

practice. Details of the protocol for this systematic review (22) were registered on PROSPERO, an international database of prospectively registered systematic reviews in health and social care.

METHODS

Literature search

Using MeSH terms and text words the following databases were searched for studies between the date indicated and November, 2014: MEDLINE (1946); EMBASE (1974); and PsycINFO (1967). The reference lists of prior literature reviews, as well as reference lists from studies included in this review, were used to identify other potentially relevant articles. In addition, an advanced search was conducted in Google Scholar. Searches were limited to literature published in English. MeSH terms and full search strategies for each database are included in the supplementary materials (Appendix A).

Study inclusion/exclusion criteria

Definition of 'environmental intervention'

Interventions that met both of the following definitions for environmental interventions were eligible: 1: "strategies that do not require the individual to self-select into a defined educational programme (i.e., self-help classes, counselling, or groups)" (p62; 20); and 2: "Interventions that involve altering the properties or placements of objects or stimuli within micro-environments with the intention of changing health-related behaviour... implemented within the same micro-environment as that in which the target behaviour is performed, typically requiring minimal conscious engagement, can in principle influence the behaviour of many people simultaneously, ...not targeted or tailored to specific individuals" (p1220; 18).

Type of intervention

Eligible studies were those that evaluated interventions comprised of an environmental change in the workplace. In the case of multi-component interventions (that is interventions including both environmental change/s and individual behaviour change/s, and/or where dietary behaviours were targeted in addition to physical activity) studies were only included if the dietary environmental component was substantial ($\geq 50\%$) or the dietary environmental component was likely to have a distinguishable, direct and/or unique impact on the outcome measure. Studies which included an environmental intervention component but where it was not possible to estimate the effect of the environmental component on eating behaviour, were not eligible for inclusion.

Outcomes

Studies were eligible for inclusion if they reported the effects of the intervention on behavioural measures of eating behaviour or physiological measures associated with eating behaviour.

Primary outcome(s): 1) Objective measures of change in eating behaviour (e.g., point-of-purchase analysis of food content; objective measures of fruit and vegetables consumed); 2) subjective measures of change in eating behaviour (e.g., self-reported amount of fruit and vegetables consumed, sugary foods / drinks consumed, high-fat / low-fat food consumed, high-fibre / low-fibre food consumed).

Secondary outcome(s): 1) Objective measures of changes in weight-related indices (e.g., Body Mass Index [BMI], body fat percentage, body weight); 2) Subjective measures of change in weight-related indices (e.g., self-reported weight, BMI, body fat percentage).

Where possible, data provided were used to calculate Cohen's d, a standard measure of effect size, using a calculator provided by the Campbell Collaboration (23).

Intervention context

For a study to be included, the environmental intervention must have been conducted within a workplace, or must have been carried out in an environment which was frequented by employees for the purposes of eating.

Study design

We included all study designs, not just randomised controlled trials (RCTs) for two reasons. Firstly, before-after designs at a single site are common in this area and we aimed to capture as many relevant studies as possible. Secondly, it may not be ethical or possible in this context to randomly allocate workers to different eating conditions. A strong focus on internal validity in an area where RCTs are not necessarily appropriate may result in biased estimates of effectiveness and may prevent the inclusion of interventions with stronger external validity (24).

Language

Only studies written in English language were eligible for inclusion.

Study selection process

One reviewer (DQ) developed the search strategies for each of the databases and conducted the searches. All potentially relevant titles and abstracts were downloaded into Refworks and duplicates were removed. Abstract and title screening were done by the same reviewer, and they were scored as: (1) 'positive' (if inclusion criteria were certainly met), (2) negative (if inclusion criteria were certainly not met), or (3) as 'unclear' (if the coder was unsure, or if not enough detail was provided in the abstract to make a decision). Full text screening was done for articles scored as with a 'positive' or 'unclear' score (N=95). Articles about which doubts remained after examining the full text, were reviewed by two additional reviewers (MdB and JA). Disagreements were resolved by discussion between the three reviewers.

Data extraction and management

Data were extracted into a structured pro forma which had been developed at the start of the systematic review. Two of the reviewers (DQ & KB) extracted study characteristics and outcomes from all studies into a data extraction table. Any disagreements were resolved by discussion amongst all reviewers.

Risk of Bias

Since the majority of studies were (cluster) randomised (controlled) trials, the Cochrane risk of bias tool was used. This tool allows researchers to systematically assess specified elements of the design, conduct, analysis and reporting of studies in order to quantify the risk that bias is present and may have affected the accuracy of the reported outcome. Users of the tool make a judgement for each item about whether risk of bias is likely to be low, medium or high and record the justification for their decision. If insufficient information is available, a judgement of unclear is recorded. Additional risk of bias criteria were added based on the RATIONALE tool (25), which elaborates on the 'other risks of bias' included in the Cochrane tool. Additions to the Cochrane tool were, first, extending the evaluation of selection bias with recruitment bias (for cluster trials) and chance bias (relevant when small numbers of people or cluster are randomised). Second, the risk of contamination and inappropriate intervention administration (fidelity) were assessed. Finally, stopping early for benefit because of a large intervention effect, or continuing with recruitment because of a smaller-than-expected intervention effect were coded. Trials could score High, Low, Unclear, or N/A (not applicable to that trial design) on these different criteria. Two of the reviewers (DQ & KB) independently coded all included studies against the RATIONALE criteria. Disagreements were resolved with the help of a 3rd coder (MdB).

Reporting quality: intervention

The quality of reporting of the interventions was evaluated using the Template for Intervention Description and Replication Checklist (TIDieR; 26). The TIDieR checklist has 12 items: 1. brief name of the intervention, 2. why this intervention was delivered (rationale), 3. what was delivered (intervention materials and activities), 4. what was the procedure for delivering the intervention, 5. who provided the intervention, 6. how was this intervention delivered, 7. where was the intervention delivered, 8. when and how much of the intervention were people exposed to, 9. planned tailoring of the intervention, 10. modifications to the intervention during the study, 11. what was the intended intervention delivery, and 12. how well was the intervention actually delivered. One reviewer (DQ) coded all included studies against the TIDieR criteria; and a second reviewer (KB) checked the coding for consistency. Any disagreements were resolved via discussion amongst all reviewers.

Coding of the interventions

The environmental interventions were coded against the Emergent Typology of Intervention Types (18). This typology describes 9 different types of environmental interventions observed during a large scoping review of the literature and provides definitions of each. The 9 types of intervention are summarised as those which primarily alter the properties of objects or stimuli (ambience, functional design, labelling, presentation, sizing), those which primarily alter the placement of objects or stimuli (availability, proximity) and those which primarily alter both properties and placement of objects or stimuli (priming, prompting). One type of intervention – financial – was added to this typology (e.g., making something healthy cheaper or something unhealthy more expensive), as many included studies contained a financial component. Two of the reviewers (DQ & KB) independently classified all included studies according to the emergent typology. Inter-rater agreement was 0.756 (Cohen's kappa) indicating moderate or substantial agreement depending on the criteria used (27-28). Any disagreements were resolved via discussion amongst all reviewers.

Analysis

Due to substantial heterogeneity in study design, study quality, types of interventions, and outcome measures, meta-analysis was not possible and data were synthesized narratively (i.e. described in words and text rather than statistically combined).

RESULTS

The search identified 8517 potentially relevant articles. After removal of duplicates and title review of the remaining articles, 7952 articles were excluded. The titles and abstracts for the remaining 565 articles were downloaded for review against the inclusion criteria by one

reviewer (DQ). After title and abstract review, 95 articles were retrieved for full text assessment. Overall, 22 studies met the inclusion criteria. The results of the literature search and the selection process are presented in Figure 1.

Characteristics of included studies

The environmental interventions were evaluated with a range of different study designs: 1 randomised controlled trial, 9 cluster randomised trials, 2 trials with intervention/control clusters matched on relevant characteristics (e.g., size of the workplace), 4 trials with intervention/control clusters without randomisation or matching, 4 pre-post evaluations, and 2 interrupted time series studies. The sample size in the studies ranged from 38 to 3119 (mean (sd) = 815,4 (888,5); median (IQR) = 439 (786,0)) (based on 19 trials that evaluated individuals rather than sales data). The duration of intervention delivery ranged from 2 weeks to 2 years. Typical outcome measures were self-reported fruit and vegetable consumption, sales data, and physiological outcomes (such as weight and BMI). Fifteen trials were conducted in the USA, 7 in Europe (2 in Denmark and 5 in the Netherlands), 1 in Brazil, and 1 in Japan. For these and other descriptives, see Table 1.

Risk of bias

The risk of selection bias (see Table 2 for an overview) was considered high in 8 trials, unclear in 8 trials due to incomplete reporting, and low in none of the trials. Twelve trials examined baseline differences in sample characteristics and did not find any; if we assume that this would capture all relevant prognostic covariates and the analyses are well-powered, we could assume 12 studies have a low, 3 a high, and 1 an unclear risk of selection bias. Selection bias was coded as not applicable for studies with a pre-post or time series design. Detection bias was considered low in 8 trials - mainly because outcomes were collected automatically (e.g., purchase data), high in 2, and unclear in 11 due to incomplete descriptions. Performance bias was considered high in 2 trials as participants and/or managers were aware of the interventions delivered in their setting, and unclear in 18 trials due to incomplete reporting. Attrition bias was low in 10 trials due to either the use of sales data with no attrition, the use of statistical techniques such as multiple imputation to account for attrition, or similar levels of attrition in the intervention and control group plus demonstration that completers were not significantly different from non-completers. Attrition bias was deemed high in 4 trials, and unclear in 8 trials. Reporting bias, reflecting on whether the outcomes reported were pre-planned, was low in 2 trials and unclear in the other 20. The risk of contamination was considered low in 20 trials due to either spread geographically (in the case of cluster trials) or in time (in the case of within-subject comparison designs). Whether the interventions were appropriately administered was

unclear in 15 trials, as it was either not reported or not assessed, and low in 7 trials. Finally, the risks that trials were halted prematurely because of obvious benefits or where recruitment continued because intervention effects were 'almost significant' was considered low in 4 trials and unclear in the remaining 18, mainly because plausible sample calculations (published in the manuscript or in a study protocol) were not given.

Descriptions of the interventions

As outlined in Table 1, of the 22 interventions described in the 24 included studies, the majority were comprised of multiple different elements (e.g. educational messages used in combination with point of purchase prompts, or changes to the availability of healthy foods). Only 5 tested the effectiveness of a single intervention strategy in isolation: increasing availability of healthy foods (29,30), labelling healthy options at the point of purchase (31/32, 33) or labelling all foods with their calorie content (34). In terms of frequency of use, the most commonly used strategies were labelling (either with calorie content or an indicator of relative 'healthiness'; used in 15 interventions), changes to the availability of healthy foods (used in 15 interventions) and point of purchase prompts (used in 13 interventions). Six studies included financial elements (reducing the cost of healthy options or providing them for free). Few interventions attempted to change the way in which foods were presented (1 intervention), to alter the portion sizes available (2 interventions), to unconsciously prime consumers to choose healthier products (3 interventions) or to change the relative proximity of healthier foods (4 interventions). None of the included interventions aimed to alter the ambience of the workplace food environment or to change the functional design of cafeterias, tableware, or cutlery. The relative use of different types of environmental intervention (using Hollands et al's typology plus one additional category to capture financial intervention strategies) is summarised in Table 3.

Intervention reporting

All included papers were coded against the TIDieR checklist to ascertain the quality of the reporting of the intervention. As shown in Table 4, all included papers specified the name of the intervention (BRIEF NAME), the mode of delivery (HOW), and the location in which the intervention occurred (WHERE). All interventions except two described the theoretical rationale or aim (WHY) and materials used (WHAT materials). Reporting on the procedures applied (WHAT procedures) was not as robust, with 8/22 failing to adequately report this information. Reporting on the timeline and dose of the interventions described was similar, with 9/22 studies not describing the number of times the intervention was delivered, the period of time the intervention was delivered over, or the dose or intensity of the intervention (WHEN and HOW MUCH). The majority of studies (15) did not adequately report who had

designed and delivered the intervention (WHO PROVIDED), the planned strategies for ensuring adherence/fidelity (14 did not report this; HOW WELL planned) or actual adherence/fidelity (17 failing to report; HOW WELL actual). Twenty studies did not report whether the intervention was modified or tailored during the study.

Outcomes: effects of the interventions

Of the 22 interventions, all reported a behavioural outcome (defined as the primary outcome in this review). Eleven of these were objectively recorded through sales data. Nine were based on self-reported data by consumers. In one trial photos of purchases were taken and coded, and in one other a research assistant coded purchases made at the counter. Physical outcomes such as weight and BMI (defined as secondary outcomes in this review) were reported in only 3 trials. In one trial, weight was measured, and in another height and weight of participants was measured by study staff. In the 3rd trial weight and height was measured by health care professionals.

For the behavioural outcomes, 13/22 trials (6/9 with self-reported measures, 5/11 with the sales data, and 2/2 where coders scored purchase behaviour) reported significant effects on the primary measures, and two studies with multiple behavioural outcomes reported significant effects on some measures but not on others. Effect sizes could be extracted or calculated for only 8 trials, with the Cohen's d ranging from 0 to .52 (no effect to a medium sized effect).

For the physical outcomes, Brehm et al. (35) found no differences in calorie intake in their cluster RCT, and no differences were found on weight or BMI (p-value and effect size not reported). Goetzel et al. (36,37) found no effect on the risk of poor nutrition and no significant reductions in the prevalence of overweight / obese employees in intervention sites, yet report significant effects on weight and BMI at 12 and 24 months post-intervention. The absolute effects were small (-0.3 BMI units; DID of -1.9lb and -1.6lb at month 12 and 24 respectively) and presumably significant because of the large sample size (n=3119 and 2431 at month 12 and 24 respectively). Lowe and colleagues (38) found a significant reduction in the energy content of lunch purchases, but this did not result in a change in weight.

DISCUSSION

This systematic review reveals that the current evidence-base does not enable clear recommendations to be made on the implementation of environmental interventions to change eating behaviour within the workplace setting. Across the 22 included studies, more than half (59%) produced significant effects on behaviour, with effects reported being:

increases in fruit and/or vegetable consumption, increases in sales of healthy options, and reductions in the number of calories purchased. Although the results look promising, effect sizes could often not be calculated, and where they could (usually for studies with significant effects) they had small-medium effects. Little evidence was identified that these interventions resulted in meaningful (or significant) changes in weight or BMI: only 1 study (36,37) showed small yet significant improvements in weight and BMI, but as no effects were observed on food intake, this begs the question whether this was through another pathway (e.g., physical activity), mere chance, or the result of bias (see Table 2). Additional concerns were that many studies had a high or unknown risk of bias; that poor reporting of interventions and comparator arms made it hard to code the content and intensity of the interventions; and that the only trial (39) that measured compensatory behaviours, found that participants receiving a smaller meal in the worksite café (as part of the intervention) were more likely to have a starter and a larger portion of the main meal when they later ate outside the workplace. Hence, we conclude that more rigorous, comprehensively-reported studies that account for compensatory behaviours are needed to fully understand the impact of environmental interventions on diet and importantly, on weight/BMI outcomes.

Many studies contained the elements needed for a high quality trial. For example, about half used objectively measured outcomes (based on purchasing data) rather than relying on self-report. The number of participants exposed to the interventions under test was typically high and the sampled participants represented diverse socioeconomic groups. Also, about half of the included studies employed randomised and cluster randomised designs. Vermeer and colleagues (39) illustrated how it is possible (and important) to assess whether people compensate later after eating less in the workplace. There were many well-informed interventions that appeared affordable and feasible, although most contained three or more different elements (and some up to 15); and many trials either did not report, or did not report in enough detail, exactly what happened in the control condition. These factors make it difficult to identify the 'active ingredients' of the intervention, or to conclude precisely what works and for whom. Ideally, study designs would be simplified in order to properly assess the potential active ingredients; and would also assess and report in detail what the control group participants are exposed to – as variation in the treatment that control groups receive can substantially influence effect sizes of behaviour change interventions (25,40). Hence, although the current review does not permit drawing any firm conclusions about what works and should be implemented, it does provide a comprehensive overview of current studies and interventions, to inform the design of future, high-quality trials.

The present results are broadly comparable with other similar reviews in the field. For example, Engbers et al. (20) in their review of general workplace health promotion programmes concluded that interventions which include an environmental component do appear to be associated with changes in eating behaviour (fruit and vegetable consumption in particular). However, this review focused on programmes which included both individual and environmental components (e.g. individual counselling plus food labelling) so the intervention effects observed could not be solely ascribed to environmental components. As in the present review, Engbers and colleagues found no evidence that worksite health programmes produce changes in physiological indicators of health (in Engbers et al's case - serum cholesterol levels, BMI, body fat or blood pressure). The three reviews which did find worksite programmes to be associated with physiological outcomes (weight, BMI; 41-43) looked specifically at interventions designed to prevent weight gain and which were typically comprised primarily of individual level intervention strategies combined with some degree of environmental intervention.

Study classification

In addition to the main research questions, the present study aimed to assess the utility and coverage of the recently published typology of choice architecture interventions (18) when used to classify real world interventions. All studies included in the present review could be successfully coded into one or more of the categories included in the emergent typology, suggesting good coverage. However, six studies contained financial elements (e.g. providing fruit for free, reducing the cost of healthy options) which were not captured by the typology in its present form. This reflects the fact that economic and financial incentives were deliberately omitted from the typology during development (44) on the basis of the original description of choice architecture: "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives" (45). However, we would contend that financial interventions should be considered environmental interventions as "*strategies that do not require the individual to self-select* into a programme" (20) and as "*interventions that involve altering the properties... of.... stimuli within micro-environments with the intention of changing health-related behaviour*".

During coding of studies, the typology categories priming and prompting were difficult to distinguish between – many interventions in this area appeared to be both adding prompts to the environment and priming healthier thoughts, suggesting that tighter specification of these categories may help coders to use the typology more reliably. Interestingly, there were marked differences in the types of intervention strategies most commonly employed by

studies in the review, with the focus very firmly on changes to labelling, availability (i.e. increased or decreased provision of certain options) and the introduction of prompts to the environment. No studies altered the ambience of the food environment, the presentation of foods on offer or the functional design of the environment / objects within that environment and only two studies altered the sizing of food portions despite evidence suggesting that these are all potentially viable ways to change food choice and consumption (46,47).

Reporting considerations

Across the included studies, reporting quality was suboptimal. In particular, there was little reporting of effect sizes (or data allow their calculation). This is a substantial barrier to efficient evidence synthesis. Similarly, intervention descriptions were usually insufficiently detailed to code risk of bias with a high degree of confidence. Only 1/22 studies had a registered protocol and none included all of the information that current best practice guidelines (26) recommend. While this may to some extent reflect pressure for space and word limits prescribed by journals, supplementary materials are increasingly accepted by publishers so it should be possible to include all key information. One notable finding from the coding of interventions against the TIDieR guideline recommendations was that most studies failed to report planned or actual strategies to assess intervention fidelity. Fidelity is likely to be extremely important in the context of environmental interventions – for example, were the posters visible to customers?, were table leaflets replaced if they were removed?, were smaller portions actually available when advertised?, etc.

The broader context

If successful workplace based dietary interventions can be identified, both employers and employees stand to benefit. As highlighted in the International Labour Organisation's Food at Work Report (48), hungry and/or unhealthy employees take more time off work, are less productive and make more mistakes, so it is in employers' own interests to introduce initiatives that prioritise worker health and nutrition. Similarly, the ILO report also argues that employees have a right to expect that their health will be prioritised in the workplace, and that employers should consider access to healthy foods (and restrictions in unhealthy foods) to be just as important as protection from other factors known to negatively impact health (e.g. noise, hazardous chemicals etc). Such strategies if implemented, would have to be introduced equitably across employees at all different levels of the socioeconomic spectrum if they are to reduce rather than widen health inequalities in the workforce.

Strengths and Limitations

The present review was the first to focus exclusively on environmental interventions to change eating behaviour in the workplace. An inclusive search strategy enabled a relatively large number of relevant studies to be identified. Included studies were comprehensively assessed in terms of their quality and reporting, and all (barring financial interventions) could be reliably coded into the emergent typology of choice architecture interventions. In terms of limitations, the heterogeneity in the identified studies precluded meta-analysis of the effectiveness of this type of intervention and coding for intervention reporting was done by a single coder, although this coding was supplemented with frequent quality checks by 2nd and 3rd coders and agreement was 100%.

CONCLUSION

In conclusion, while around half of the identified environmental ‘choice architecture’ interventions seemed to successfully change eating behaviour in the workplace, the design and reporting of studies was generally poor, effect sizes were small to medium, and there was no compelling evidence that this translated into changes in weight or BMI. Despite these limitations, the included trials have several evident strengths that could inform the development of future interventions and the design of rigorous trials. To advance our understanding of what environmental changes are feasible and effective, environmental intervention designers should consider using simpler interventions *or* more complex trial designs (e.g., factorial) that allow the effectiveness of single intervention components to be identified. If these intervention trials are then reported at the level of detail recommended by current best practice guidelines – as utilised in this systematic review – they could establish conclusively whether environmental interventions for dietary behaviours in the workplace have any merit.

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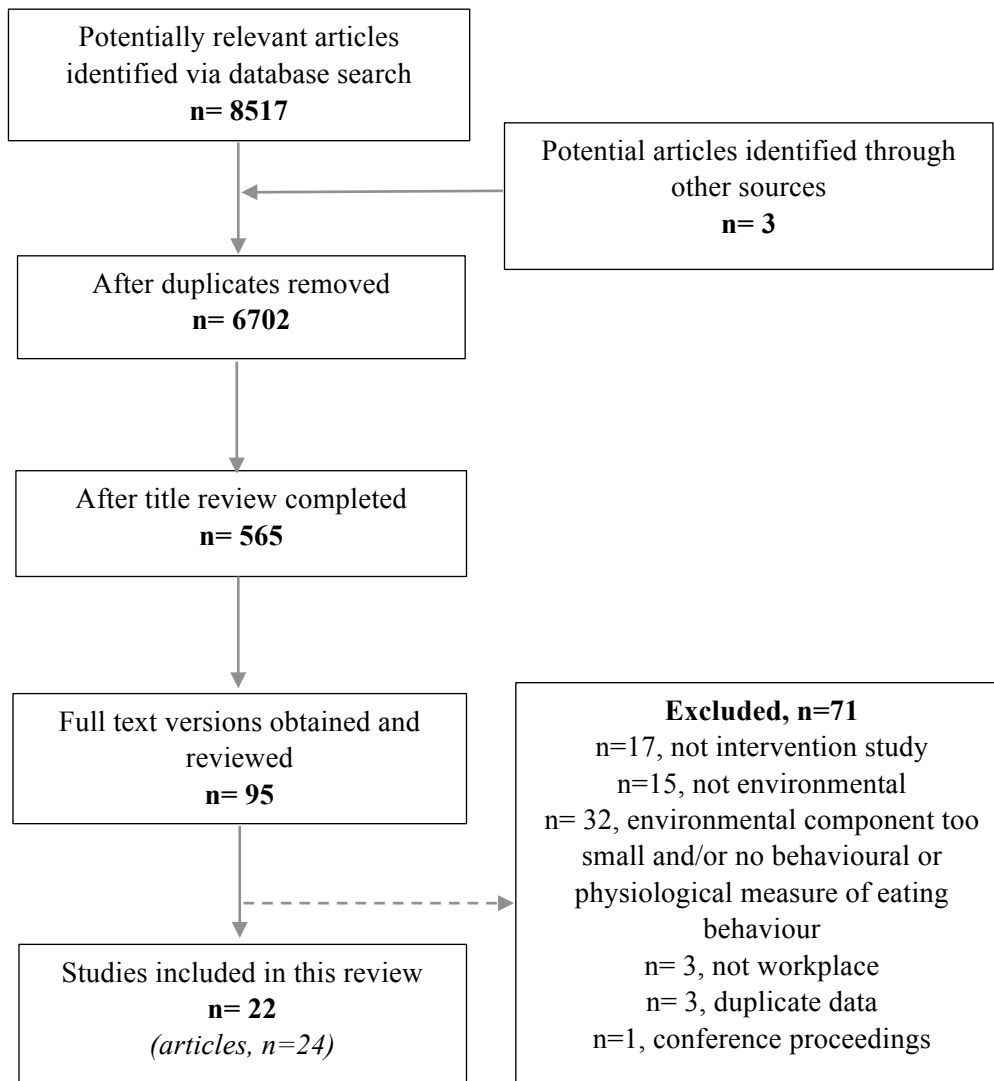


Table 1: Summary of included studies

Author (year)	Study design	Sites	Sample (n)	Intervention	Comparison group	# of arms	Duration of intervention	Outcomes		Effect measure	
								Primary (behavioural)	Secondary (BMI or weight)	Primary	Secondary
Alinia et al. 2010 (29)	Controlled trial: clusters	8 (INT=5; CTL=3).	While collar and blue collar workers in Denmark, n = 146 (INT=82; CTL=64)	Daily fruit basket with least one piece of fruit per participant per day.	Control sites: did not have free fruit at the workplace	2	5 months	Self-reported fruit consumption.	not available	Employees at INT sites had higher fruit intake than CTL, DID of 102g. P-value: p=.021. Effect size: d=0.42.	N/A
Backman, Gonzaga et al. 2011 (30)	Cluster randomised trial	9 (INT= 6; CTL=3)	Low-income workers in apparel manufacturing and food processing in the USA, n = 528 (INT=391; CTL=137)	Fruit basket 3 times a week, with 1 serving of fruit per employee	Control worksites did not receive fruit deliveries during the intervention period, but commenced the same schedule of deliveries approximately 1 week after the study was completed.	2	12 weeks	Self-reported fruit and vegetable consumption.	not available	Fruit consumption and veg consumption increased in INT compared to CTL P-value: p=.02 for fruit, p<.01 for veg. Effect size: could not be computed.	N/A
Backman, Cheung et al. 2011 (49)	Pretest-posttest design	8 (all INT)	Customers of catering trucks servicing low-income worksites in San Diego, USA, n = N/A (sales data analysed)	Two new healthful entrees added to the menu during baseline period. During promotion period, healthful entrees were repackaged onto glossy black trays, marked with promotional stickers, employees wore clothing that promoted healthy eating, and a promotional sign was posted in the specials area.	N/A	1	5 weeks	Sales data:number of healthful options sold per week.	not available	Sales increased by 37.4% for the turkey sandwich and 14.4% for the chicken wrap on promotion versus baseline. P-value: not reported. Effect size: could not be computed.	N/A
Bandoni et al. 2010 (50)	Cluster randomised trial	29 (INT=15; CTL=14)	Employees of private sector companies, most from the industrial sector in Brazil, Baseline n=1296 (INT=645, CTL=645); 6mth FU n=1214 (INT=630; CTL=584)	Multicomponent intervention with elements aimed at cafeteria staff and other employees. Environmental component targeted at eating: flipcharts promoting F&V consumption put on all tables in cafeteria, healthy options / options with high F&V highlighted. Also included education and demonstrations.	Control worksites: no information provided.	2	6 months	Self-reported fruit and vegetable consumption.	not available	Adjusted DID of 49.05g (8.38, 89.71) for fruit and vegetable intake. P-value: not reported. Effect size: d=0.16	N/A

Beresford et al. 2001 (51)	Cluster randomised trial	28 (INT=14; CTL=14)	Employees in various types of businesses in the USA, baseline n=2742 (INT=1342; CTL=1400); 2yr FU n=2395 (INT=1169, CTL=1226)	Intervention targeted both environmental and individual factors. Environmental component targeted eating: educational and motivational messages about F&V consumption delivered throughout worksite via posters, brochures, table tents, paycheck inserts, flyers, newsletters, food demos, message cards, tip sheets and a self help manual. Point of purchase displays and signs were used along with promotional days (e.g. 'baked potato day') and incentives to eat F&V.	Control worksites: no information provided.	2	12 months	Self-reported fruit and vegetable consumption.	not available	INT effect of 0.3 fruit and vegetable serving at 24 months (compared to CTL). P-value: p<.05. Effect size: could not be computed.	N/A
Brehm et al. 2011 (35)	Cluster randomised trial	8 (INT=4; CTL=4)	Manufacturing workers in the USA, n=341 (INT=168; CTL=173)	Two-part environmental intervention: stimulating healthy food choices and stimulating physical activity. Environmental component targeted eating: posters prompting healthy food choice, reduced portion sizes of entrees, half portions of entrees made available, full fat cheese replaced with half fat cheeses, at least 1 healthy entree offered at any time, greater variety of F&V offered, proportion of healthy to unhealthy snacks in vending machines increased, stickers on healthy items in vending machines, posters, tables tents and handouts in cafeteria and break room (containing facts, recipes and tips), a website with healthy eating information, binders made available with suggestions for healthy foods for catering meetings and healthy options available at nearby restaurants.	Control worksites: no information provided.	2	12 months	Energy and nutrient intake (calculated based on self-report FFQ).	BMI (height and weight measured by study staff)	No significant difference in calorie intake between INT and CTL. P-value: not reported. Effect size: could not be computed. Significantly lower saturated fat and cholesterol intake in INT compared to control. P-value: p < .05. Effect size: could not be computed.	No significant difference in BMI between INT and CTL. P-value: not reported. Effect size: could not be computed.
Dorresteijn et al. 2013 (52)	Interrupted time-series design with 4 study periods	1	Customers of a single hospital cafeteria in the Netherlands, n=N/A (sales data analysed)	Environmental intervention targeting eating behaviour (salt and fat intake). Salt content of soup reduced by 30% (change highlighted with accompanying message about health benefits), reduced fat/calorie croissants made available in addition to regular ones (change highlighted with sign), location of butter and low fat margarine changed.	N/A	1	2 weeks	Sales data: number and ratio of purchased normal-salt/reduced-salt soup; butter/lean croissants; diet margarine/butter.	not available	7 fold increase in butter sales; no significant change in the healthy soup and lean croissant sales. P-value: p<.01 for butter. Effect size: could not be computed.	N/A

Engbers et al. 2006 (53)	Controlled trial: cluster matching	2 (INT=1; CTL=1)	Employees of government companies in the Netherlands, n=515 (INT=244; CTL=271)	Two-part environmental intervention: stimulating healthy food choices and stimulating physical activity. Environmental component targeted eating: information sheets placed near food products in the cafeteria and on vending machines to prompt healthier food choices by highlighting number of minutes of exercise required to burn off the calories in the targeted food, information stand in canteen with information brochures on healthy foods, blood pressure and cholesterol, introduction of a healthy buffet for staff every 2 months.	Control worksites: no information provided.	2	12 months	Self-reported fruit and vegetable and fat consumption.	not available	No significant differences between the groups at 12 months. P-value: p=.24 (fruit), p=.78 (veg), p=.26 (fat). Effect size: could not be computed.	N/A
French et al. 1997 (54)	Pretest-posttest design	1 worksite (9 vending machines at 4 locations)	University employees in the USA, n=N/A (sales data analysed)	Low-fat snacks in vending machines were clearly marked and price was reduced.	N/A	1	3 weeks	Sales data: low-fat snacks purchased per week.	not available	The sales of low-fat snacks sold increased about 80% during INT, from 25.7% to 45.8% of total sales, and then returned to 22% post-INT. P-value: p<.002. Effect size: d=0.42.	N/A
French et al. 2010 (55)	Cluster randomised trial	4 (INT=2; CTL=2)	Metropolitan transit workers in the USA, baseline n=1094 (INT=554, baseline, 513, follow-up; CTL=540, baseline, 552, follow-up)	Multicomponent intervention designed to change eating and physical activity. This included lowering prices of healthy options by 10% and increasing availability of healthy foods and beverages in vending machines to 50% of the total products available.	Control garages: no intervention.	2	18 months	Sales data: healthy vending foods purchased.	not available	The comparative healthy snack purchase ratio (INT vs CTL) was about 5. P-value: not reported. Effect size: could not be computed.	N/A
Goetzel et al. 2009 (36; Year 1 results)/ Goetzel et al. 2010 (37; Year 2 results)	Controlled trial: cluster	12 (INT=9 [INT moderate, n=4; INT intense, n=5]; CTL=3)	Employees of Dow Chemical in the USA, Y1 n=3119 (INT=2486; CTL=633); Y2 n=2431 (INT=1902; CTL=529)	Multicomponent intervention designed to increase employees' physical activity, improve eating habits and manage their weight. Environmental component targeted eating: environmental prompts encouraging healthy food choice, point of purchase messages on vending machines and in cafeteria, healthy eating information provided on all vending machines, cafeterias and at all company meetings.	Control sites: no new environmental interventions, but had an individually-focused intervention programme.	3	12 months (Goetzel et al., 2009); 2 years (Goetzel et al., 2010)	Poor nutrition risk (defined as self-report of 4+ fast food meals per week OR 2+ sweetened drinks per day OR <3 F&V servings per day).	Change in weight and BMI (weight and height measured by health professionals).	Year 1: Odds of poor nutrition = 1.1 (INT vs CTL). P-value: p=.306. Effect size: d=0.036. Year 2: DID=-5.3% (INT vs CTL, controlling for site level effects). P-value: p=.094. Effect size: logit d=-0.0609 (without controlling for baseline).	Year 1: DID between INT and CTL of -0.3 BMI units; DID of -1.9lb weight. P-value: p<.0001 for both. Effect size: d=0.252 for both. Year 2: DID of -0.3 BMI units; DID of -1.6lb P-value: p=.0028 for BMI, p=.0051 for weight. Effect size: d=0.177 for BMI, d=0.166 for weight.

Hebert et al. 1993 (31)/ Sorensen et al. 1992 (32)	Cluster randomised trial	16 (INT=8; CTL=8)	Customers of worksite cafeterias of various businesses in the USA; Hebert et al (1993) n = 1762 (INT/CTL not reported); Sorensen et al. (1992) n = 2011 (INT=947; CTL=1064)	Multicomponent intervention. Environmental component targeted at eating: labelling of healthy foods in cafeteria and on bulletin boards.	Control sites: no intervention.	2	15 months	Hebert et al. (1993): Self-reported food intake in 12 categories. Sorensen et al. (1992): Self-reported fat and dietary fibre intake.	not available	Hebert et al. (1993): Significantly larger increase in veg consumption, and marginally significantly larger decrease in processed meat consumption in INT compared to CTL. All other effects non-significant. P-values: p<.001 (vegetables), p=.05 (processed meats). Effect sizes: could not be computed. Sorensen et al. (1992): Unadjusted reduction of fat intake by 1.7% in INT compared to CTL. No sig difference in dietary fibre intake. P-value: p<.01 for fat, p=.66 for fibre. Effect size: could not be computed.	N/A
Jeffery et al. 1994 (56)	Interrupted time series design with 3 phases	1	Customers of a worksite cafeteria at a university in the USA, n=370	Environmental intervention with an economic component: increasing availability of fruit and salad bar options by 30% and reducing the price by 50%	N/A	1	3 weeks	Sales data: number of fruit purchases and pounds of salad purchased per day.	not available	Purchases of fruit and salad increased significantly, approximately threefold over baseline levels. P-value: ps=.0001 for both fruit and salad. Effect size: could not be computed.	N/A
Kushida et al. 2014 (57)	Controlled trial: cluster	16 (INT=8; CTL=8)	Customers of worksite cafeterias in various businesses in Japan, n=349 (INT=181; CTL=168)	Environmental intervention to provide nutrition information on table tents, and personalised feedback. Environmental component targeting eating: 12 types of informational table tents placed on all tables in cafeteria promoting vegetable consumption, posters in cafeteria showing where local veg was grown and highlighting which were used in each dish available in the cafeteria, local veg included in menu at least once a month.	Minimal intervention comparison group: no environmental component but both INT and CTL received personalised feedback about their nutrient intake.	2	24 weeks	Self-reported vegetable consumption.	not available	INT had increased veg consumption compared to CTL in the cafeteria (+0.16 servings) and per day (+0.18 servings). P-values: p=.05 and p=.01 respectively. Effect size: could not be computed.	N/A
Lassen et al. 2014 (33)	Controlled trial: cluster	2 (INT=1; CTL=1)	customers of hospital staff cafeterias in Denmark, n=270	Environmental intervention assessing the effect of introducing Keyhole labelled meals (indicating a healthy choice).	Control worksite: no Keyhole symbols.	2	6 weeks and then continued on	Different types of food and nutrient intake (assessed objectively by a digital photographic method).	not available	At endpoint (6 weeks), INT participants consumed less fat than CTL (DID of 13.4), also more fruit and veg, less salt and refined sugars. P-value: p<.001 for fat. Effect size: could not be computed.	N/A
Levin 1996 (58)	Controlled trial: cluster matching	2 (INT=1; CTL=1)	Customers of worksite cafeterias in government offices in the USA, n=N/A (sales data analysed)	Point-of-purchase environmental intervention: sign on entry to cafeteria instructing customers to look for the symbol indicating healthy options plus healthy heart symbol next to healthy options on the menu board.	Control worksite: same food offerings, but no intervention.	2	4 weeks (one intervention component remained on afterwards)	Sales data: low-fat menu items.	not available	Sales of low-fat items increased significantly in INT (overall X2=50.24) and remained stable in CTL. P-values: p<.001 in INT, p=.78 in CTL. Effect size: could not be computed.	N/A

Lowe et al. 2010 (38)	Randomised controlled trial (2 intervention groups)	2	Customers of hospital cafeterias in USA, n=96 (HospA, n=53; HospB, n=43)	Energy density reduction and labelling (EC). More healthy options and ingredients added to the menu, at least 1 very low energy density option available at any time, all foods labelled with colour coded labels indicating energy density.	EC-Plus (EC + additional training and incentive programme)	2	3 months	Nutritional content of food purchased in cafeteria (based on sales data).	Mean change in weight (measured by staff)	Both EC and EC-Plus decreased the overall energy content of lunch purchases. P-value: $p<.001$. Effect size: $\eta_p^2 = 0.30$.	No sig change in weight in either condition. P-value: $p=.11$. Effect size: $\eta_p^2 = 0.05$.
Milich et al. 1976 (34)	Pretest-posttest design	1	Female customers of a hospital cafeteria in the USA, n=450	Environmental intervention providing caloric content of foods to change food choice. All available foods labelled with their total calorie content.	N/A	1	2 weeks	Calories bought (computed by a dietician based on a record of all food and drink bought).	not available	During Calorie Presentation, sig decrease in the number of calories bought. P-value: $p<.008$. Effect size: $d=0.52$.	N/A
Schmitz & Fielding 1986 (59)	Pretest-posttest design	1	Customers of the worksite cafeteria of corporate HQ of Mattel Toys in the USA, baseline n=439, FU n=384.	Environmental intervention with labels presenting healthier alternatives to unhealthy foods. Signs placed at 15 locations throughout cafeteria illustrating the calorie/fat/salt content of target foods in comparison to a healthier available alternative.	N/A	1	6 months	Nutritional content of food purchased in cafeteria (based on purchases recorded by an RA).	not available	Sig decrease in the number of calories bought. P-value: $p=.01$. Effect size: $d=0.27$.	N/A
Steenhuis et al. 2004 (60)	Cluster randomised trial	17	White collar workers using worksite cafeterias in the Netherlands, n=1013	Multicomponent intervention with four different conditions: control (no intervention); education only; education + labelling; education + food supply. Environmental component targeting eating: educational posters, brochures, table tents, self-help manuals, information in newsletter, and badges for staff; availability of 6 low fat products and F&V increased; signs, posters and table tents highlighting new healthy options; healthy options labelled at point of purchase.	Control worksite: no intervention.	4	6 months	Sales data: low-fat milk, butter, cheese, meat products and deserts.	not available	Higher sales of low-fat desserts in the labelling programme (LP) as compared to education only (EP) and control (NP). No other significant differences. P-value for desserts: LP vs EP $p<.01$, LP vs NP $p<.05$. Effect size: could not be computed.	
Vermeer et al. 2011 (39)	Cluster randomised trial	25 (INT1, n=9; INT2, n=8; CTL, n=8)	Customers of worksite cafeterias in various businesses in the Netherlands, n=308 (INT only)	Introduction of a smaller portion of a hot meal in addition to the existing portion, with two pricing plans for the smaller portion: proportional pricing in INT1, value size pricing in INT2	Control cafeteria only: existing (large) size of the hot meal was available.	3	3 months	Sales data: small portion meals	not available	No effect of proportional pricing was found. P-value: $p=0.74$. Effect size: could not be computed.	N/A
Vyth et al. 2011 (61)	Cluster randomised trial	25 (INT=13; CTL=12)	Office workers who used worksite cafeterias in the Netherlands, n=368 (provided questionnaire data)	Environmental intervention assessing the effect of adding healthier food choices and the 'choices nutrition logo' on food consumption.	Control worksites: did not use labels or any other communication about the logo.	2	3 weeks	Sales data: sandwiches, soups, fried snack foods, fruit, salads	not available	Significantly higher fruit sales in the INT group compared to the CTL group. No other significant effects. P-value: $p=0.001$ for fruit sales. Effect size: could not be computed.	N/A

Note. INT: intervention, CTL: control, DID: difference in differences, CI: confidence interval. Cohen's d could be calculated for various studies but we could not correct those for baseline differences or study design (e.g., clusters).

Table 2: Risk of bias in included studies

Author(s) & year	1. Selection bias (based on 1a-1d)	1a. Sequence generation	1b. Allocation concealment	1c. Recruitment bias	1d. Chance bias: Baseline imbalance	2. Detection bias	3. Performance bias	4. Attrition bias	5. Reporting bias	6. Contamination	7. Inappropriate intervention administration	8. Stopping early for benefit; continuing with recruitment for benefit
Alinia et al. 2010 (29)	HIGH	HIGH	HIGH	UNCLEAR	LOW	UNCLEAR	UNCLEAR	HIGH	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Backman, Gonzaga et al. 2011 (30)	HIGH	UNCLEAR	UNCLEAR	HIGH	LOW	UNCLEAR	UNCLEAR	LOW	UNCLEAR	LOW	LOW	UNCLEAR
Backman, Cheung et al. 2011 (47)	N/A	N/A	N/A	N/A	N/A	LOW	UNCLEAR	LOW	LOW	LOW	LOW	UNCLEAR
Bandoni et al. 2010 (48)	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	LOW	LOW	UNCLEAR
Beresford et al. 2001 (49)	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	HIGH	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Brehm et al. 2011 (35)	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR	HIGH	LOW	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Dorresteijn et al. 2013 (50)	N/A	N/A	N/A	N/A	N/A	LOW	UNCLEAR	LOW	LOW	LOW	UNCLEAR	LOW
Engbers et al. 2006 (51)	HIGH	HIGH	UNCLEAR	LOW	LOW	UNCLEAR	UNCLEAR	HIGH	UNCLEAR	LOW	UNCLEAR	UNCLEAR
French et al. 1997 (52)	N/A	N/A	N/A	N/A	N/A	LOW	UNCLEAR	LOW	UNCLEAR	LOW	UNCLEAR	UNCLEAR
French et al. 2010 (53)	HIGH	LOW	UNCLEAR	LOW	HIGH	LOW	LOW	LOW	UNCLEAR	UNCLEAR	LOW	UNCLEAR
Goetzel et al. 2009 (36; Year 1 results)/ Goetzel et al. 2010 (37; Year 2)	HIGH	HIGH	HIGH	UNCLEAR	LOW	LOW	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Hebert et al. 1993 (31)/ Sorensen et al. 1992 (32)	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR	HIGH	UNCLEAR	LOW	LOW	UNCLEAR
Jeffery et al. 1994 (54)	N/A	N/A	N/A	N/A	N/A	LOW	UNCLEAR	LOW	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Kushida et al. 2014 (55)	HIGH	HIGH	HIGH	HIGH	LOW	UNCLEAR	UNCLEAR	LOW	UNCLEAR	LOW	UNCLEAR	LOW
Lassen et al. 2014 (33)	HIGH	HIGH	HIGH	HIGH	HIGH	UNCLEAR	HIGH	UNCLEAR	UNCLEAR	LOW	UNCLEAR	LOW
Levin 1996 (56)	HIGH	HIGH	HIGH	HIGH	LOW	LOW	HIGH	LOW	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Lowe et al. 2010 (38)	UNCLEAR	UNCLEAR	UNCLEAR	N/A	LOW	UNCLEAR	UNCLEAR	HIGH	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR
Milich et al. 1976 (34)	N/A	N/A	N/A	N/A	N/A	HIGH	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Schmitz & Fielding 1986 (57)	N/A	N/A	N/A	N/A	N/A	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Steenhuis et al. 2004 (58)	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	LOW	UNCLEAR	UNCLEAR
Vermeer et al. 2011 (39)	UNCLEAR	UNCLEAR	UNCLEAR	UNCLEAR	LOW	LOW	UNCLEAR	UNCLEAR	UNCLEAR	LOW	LOW	UNCLEAR
Vyth et al. 2011 (59)	UNCLEAR	UNCLEAR	UNCLEAR	HIGH	LOW	LOW	UNCLEAR	LOW	UNCLEAR	LOW	LOW	LOW

Note. Dark grey: high risk of bias; White: low risk of bias; Light grey: unclear; Dots: not applicable to study design

Table 3: Classification of included studies according to Holland’s et al’s emergent typology of choice architecture interventions

[illegible]

Table 4. Coding of included articles against TIDieR criteria

AUTHOR/S	BRIEF		WHAT		WHO	HOW	WHEN and			HOW WELL		
	NAME	WHY	Materials	Procedures	PROVIDED		WHERE	HOW MUCH	TAILORING	MODIFICATIONS	Planned	Actual
Alinia 2010 (29)	1383	1382-1383	1383	1383	X	1383	1383	1383	None	X	X	X
Backman 2011 (30)	S114	S113-S114	S113, S116	S116	S116	S116	S116	S116	None	X	S116	S116
Backman 2011 (47)	S155	S155	S155-S156	S156	S156	S155-S156	S155	S156	None	X	S156-S157	S156-157
Bandoni 2010 (48)	976	976	976	976	976	976	976	976?	None	X	X	X
Beresford 2001 (49)	230	230-231	231-232	231-232?	X	231-232	231-232	231-232?	231-232	X	X	X
Brehm 2011 (35)	335	X	336	336	X	336	336	335?	335 ^f	X	336	338
Dorresteyn 2013 (50)	2-3	1-2	2-3	2-3	X	2-3	2	2-3?	None ^s	X	X	X
Engbers 2006 (51)	2	1-2	2-3	2-3?	X	2-3	2-3	2-3	None	X	X	X
French 1997 (52)	849	849	849	849	X	849	849	849	None ^s	X	X	X
French 2010 (53)	S29	S30	S30	S30	S30	S30	S30	S30	None	X	S30	S31
Goetzel 2009 (36)* / 2010 (37)	127	125-126	128	127-128?	X	127-128	127-128	128?	128 ^g	X	X	X

All numbers are page references from the articles; coloured cells represent missing or incomplete information; X=no information provided; ?=mentioned but not enough detail provided to replicate; None=All sites received the same environmental intervention; ^s=single worksite; ^dtailoring refers to different intervention components; ^etailoring refers to different conditions; ^frefers to different worksites; ^gsome worksites received moderate environmental intervention, some worksites received intense environmental intervention

Table 4. (cont'd) Coding of included articles against TIDieR criteria

AUTHOR/S	BRIEF		WHAT		WHO	WHEN and					HOW WELL	
	NAME	WHY	Materials	Procedures	PROVIDED	HOW	WHERE	HOW MUCH	TAILORING	MODIFICATIONS	Planned	Actual
Hebert 1993 (31) / Sorensen 1992 (32) [#]	506 [#]	507-509 [#]	510-511 ^{#?}	510 ^{#?}	X	507-510 [#]	509 [#]	506?	510-511 ^c	X	509 [#]	X
Jeffery 1994 (54)	788	X	789	789	X	789	789	789?	None ^s	X	X	X
Kushida 2014 (55)	351	350-351	352	352	352	352	352	351	None	352	X	?
Lassen 2014 (33)	129	128-129	129?	129?	X	129	129	129?	None	X	X	X
Levin 1996 (56)	282	282	282	282?	X	282	282	283	None	X	X	X
Lowe (2010)	144	144	145-146	145-146?	X	145-146	145	145-146	None ^s	X	X	X
Milich (1976)	155	155-156	158-159	158-159	158?	158-159	158	158	None ^s	158	X	X
Schmitz & Fielding 1986 (57)	S66	S65-S66	S66-S67	S67	S67	S66	S66	S66-S67	None ^s	X	S67	X
Steenhuis 2004 (58)	336	335-336	337-338	337-338?	X	337-338	337	337	337-338 ^d	X	X	X
Vermeer 2011 (39)	1201	1200-1201	1202	1201?	1201	1201	1201	1203	1202 ^e	X	1201	1204
Vyth 2011 (59)	132	131-132	133	133	133	133	133	133?	None	X	133	X

All numbers are page references from the articles; coloured cells represent missing or incomplete information; X=no information provided; ?=mentioned but not enough detail provided to replicate; None=All sites received the same environmental intervention; ^s=single worksite; ^dtailoring refers to different intervention components; ^etailoring refers to different conditions

Appendix A. Database search strategies

MEDLINE 1946 to November week 4 2014

1. Workplace/
2. (work adj1 (site? or place? or location? or setting? or environment?)).tw.
3. worksite.tw.
4. or/1-3
5. Feeding Behavior/
6. Eating/
7. (eating adj3 (habit? or preference?)).tw.
8. (intake adj3 (salt or sugar or fat)).tw.
9. (reduc\$ adj3 (salt or sugar or fat)).tw.
10. (calorie? or portion? or packag\$ or label\$ or traffic light).tw.
11. food habits/ or food preferences/
12. (meal? or snack?).tw.
13. food services/ or restaurants/
14. (canteen? or cafeteria? or restaurant? or vending machine? or cater\$).tw.
15. Fruit/
16. Vegetables/
17. Health Behavior/
18. (health adj3 (behaviour or promotion)).tw.
19. or/5-18
20. exp Diet/
21. (dietary or nutrition).tw.
22. 20 or 21
23. Obesity/
24. (weight or weight-loss or weightloss or BMI or body mass index).tw.
25. 23 or 24
26. 4 and 19
27. 4 and 22
28. 4 and 25
29. 4 and (19 or 22)
30. 4 and (19 or 25)
31. 4 and (22 or 25)
32. 4 and (19 or 22 or 25)

EMBASE 1974 to 2014 to November 25

1. workplace/
2. (work adj1 (site? or place? or location? or setting? or environment?)).tw.
3. worksite.tw.
4. or/1-3
5. feeding behavior/ or nutrition/ or eating habit/ or food preference/ or portion size/
6. eating/
7. (eating adj3 (habit? or preference?)).tw.
8. (intake adj3 (salt or sugar or fat)).tw.
9. (reduc\$ adj3 (salt or sugar or fat)).tw.
10. (calorie? or portion? or packag\$ or label\$ or traffic light).tw.
11. food intake/ or food packaging/ or food preference/
12. (meal? or snack?).tw.
13. catering service/
14. (canteen? or cafeteria? or restaurant? or vending machine? or cater\$).tw.
15. fruit/
16. vegetable/
17. health behavior/
18. (health adj3 (behaviour or promotion)).tw.
19. or/5-18
20. exp diet/
21. (dietary or nutrition).tw.
22. 20 or 21
23. obesity/
24. (weight or weight-loss or weightloss or BMI or body mass index).tw.
25. 23 or 24
26. 4 and 19
27. 4 and 22
28. 4 and 25
29. 4 and (19 or 22)
30. 4 and (19 or 25)
31. 4 and (22 or 25)
32. 4 and (19 or 22 or 25)

PsycINFO 1967 to December week 1 2014

1. working conditions/
2. (work adj1 (site? or place? or location? or setting? or environment?)).tw.
3. worksite.tw.
4. or/1-3
5. exp diets/

6. (eating adj3 (habit? or preference?)).tw.
7. (intake adj3 (salt or sugar or fat)).tw.
8. (reduc\$ adj3 (salt or sugar or fat)).tw.
9. (calorie? or portion? or packag\$ or label\$ or traffic light).tw.
10. dietary.tw.
11. (health adj3 (behaviour or promotion)).tw.
12. (weight or weight-loss or weightloss or BMI or body mass index).tw.
13. ((fruit or vegetables) adj3 (intake or consum\$)).tw.
14. or/5-13
15. food intake/
16. (meal? or snack?).tw.
17. (canteen? or cafeteria? or restaurant? or vending machine? or cater\$).tw.
18. or/15-17
19. 4 and 14
20. 4 and 18
21. 4 and (14 or 18)